E. SOLID OXIDE FUEL CELLS AND DEPARTMENT OF DEFENSE APPLICATIONS

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TACOM
Mobility and Firepower for America's Army

Solid Oxide Fuel Cells and Defense Applications

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SOFC's and Defense Applications

Outline

- **Armed Services Interests**
- **Fuel - The sulfur problem**
- **Efficiency - A key logistic issue**
- **PEM versus SOFC**
- **A way forward in ground vehicles**
- **Wrap up**

SOFC's and Defense Applications

Military Fuel Cell Applications

- **Navy**
  - **Ship service power**
  - **Ship Propulsion**
- **Air Force**
  - **Bare Base - tent city power**
  - **Flight line generator replacement**
- **Army and Marines**
  - **Ground vehicle APUs and propulsion**
  - **Mobile Generators**
  - **Soldier Power**

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SOFC's and Defense Applications

Fuel - The sulfur problem

- **Navy**
  - **Ship fuel allows up to 10,000 ppm sulfur**
  - **JP-5 jet fuel allows up to 4,000 ppm**
- **Air Force and Ground Forces**
  - **JP-8 is the single peacetime and battlefield fuel**
  - **3,000 ppm S limit**
- **Overseas fuels can have very high sulfur levels**
- **Historically low JP-5/8 sulfur levels are increasing**

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SOFC's and Defense Applications

Efficiency and Emissions

- The U.S. has moved from forward basing to force projection
- Logistic support structures must be kept small
  - Less vulnerable supply systems
  - Faster to deploy
  - Less expensive in peace or war
- 70% of the Army's bulk supply burden is fuel
- Emissions are a real military concern
  - Most military activity is peacetime
  - Military trucks are affected now - ships and aircraft later

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PEM: Advantages and Issues

- Advantages
  - PEM fuel cells are available
  - Good efficiency
  - High rate of commercial investment in PEM technology
- Issues
  - Difficult cooling in high ambient temperature
  - Noble metal catalysts - cost and scarcity
  - Complex reformer
    - Poor sulfur tolerance
    - Must remove carbon monoxide
    - Penalizes efficiency and power density

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SOFC: Advantages and Issues

- **Advantages**
  - **Excellent integration with simplified reformer**
  - **Potential efficiency of combined cycle**
  - **Heat rejection is much easier**
    - **Promotes high power density propulsion systems**
    - **Long term military vehicle propulsion candidate**
- **Issues**
  - **Much less mature than PEM**
  - **Scale up to large vehicle systems**
  - **Slow startup**

SOFC's and Defense Applications

A Way Forward in Ground Vehicles

- **SOFCs offer excellent features for future heavy vehicles, especially military vehicles**
- **Commercial success of SOFCs is the key to broad military adoption**
- **Long haul truck Auxiliary Power Units (APUs) are a major commercial entry point for SOFCs**
  - **Solution to anti-idling restrictions**
  - **Support for separately-powered engine accessories**
- **The APU builds the base for SOFC engines**

SOFC's and Defense Applications

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